

Tropical Cyclone Report
Hurricane Beatriz
(EP022011)
19-22 June 2011

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Beatriz was a short-lived hurricane whose eyewall passed over the coast of southwestern Mexico. The hurricane then turned away from the coast and abruptly dissipated.

a. Synoptic History

The genesis of Beatriz was complex. A tropical wave emerged from the west coast of Africa on 4 June and reached the western Caribbean Sea by 14 June. An atmospheric Kelvin wave from the western Pacific was enhancing low-level vorticity and upward vertical motion east of 110°W at the time the tropical wave reached the eastern Pacific on 15 June. The tropical wave entered this favorable environment, and satellite pictures revealed that a weak and slow-moving low- to mid-level cyclonic circulation formed along the tropical wave several hundred miles south of El Salvador by 16 June. Around this time, a faster-moving easterly wave entering the region from Central America reached the cyclonic circulation spawned by the first wave. An elongated surface low with multiple centers resulted from the interaction of the two waves several hundred miles southeast of Acapulco, Mexico, on 17 June.

Convection gradually increased along the western end of the trough during the next 24 h, and a loosely organized curved band developed near one of the circulation centers by early on 18 June. A 1630 UTC ASCAT pass that day indicated that the westernmost circulation, closest to the concentrated convection, was becoming dominant, and it is estimated that a well-defined area of low pressure formed from this circulation by 1800 UTC 18 June about 300 n mi south-southeast of Acapulco. While the coverage of the convection briefly decreased after 0000 UTC 19 June, a concentrated burst of deep convection developed over the center around 0600 UTC, and a tropical depression is estimated to have formed around that time about 225 n mi south-southeast of Acapulco. The “best track” chart of Beatriz’s path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1¹.

¹ A digital record of the complete best track, including wind radii, can be found on line at <ftp://ftp.nhc.noaa.gov/atcf>. Data for the current year’s storms are located in the *btk* directory, while previous years’ data are located in the *archive* directory.

After its formation, the depression moved generally west-northwestward to northwestward around the southwestern periphery of a mid-tropospheric ridge centered over the northwestern Caribbean Sea. The cloud pattern became better organized, and the depression strengthened into a tropical storm around 1800 UTC 19 June about 170 n mi south-southwest of Acapulco. In a moist and low shear environment and over sea surface temperatures of 29°-30°C, Beatriz quickly intensified during the next 24 h. Data from a U.S. Air Force Reserve Hurricane Hunter mission around 1800 UTC 20 June indicated that Beatriz reached hurricane strength around that time while located about 180 n mi south-southeast of Manzanillo, Mexico. Near this time, the cyclone turned north-northwestward and its forward speed decreased as it moved into a weakness in the subtropical ridge over Mexico caused by an unusually strong shortwave trough moving through the western United States.

The intensification phase continued until Beatriz was almost at the southwestern coast of Mexico around 0600 UTC 21 June, when the hurricane is estimated to have reached a peak intensity of 80 kt (Figure 4). The forward speed of the hurricane increased at this point in response to a rebuilding of the subtropical ridge over Mexico, and the heading gradually shifted from north-northwestward to northwestward. The eye passed within 15 n mi of the coast between 0600 and 0900 UTC, with the northern eyewall brushing coastal areas to the southeast of Manzanillo. The interaction of the circulation with the high terrain of the Sierra Madre del Sur likely contributed to the rapid weakening of Beatriz observed after this time, with Beatriz becoming a tropical storm by 1200 UTC that day. The cloud pattern of the storm continued to rapidly lose organization during the day as the storm turned westward and slowed. Beatriz is estimated to have dissipated while centered 75 n mi west of Manzanillo by 0600 UTC 22 June, about 24 h after achieving its peak intensity.

b. Meteorological Statistics

Observations in Beatriz (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), as well as flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from one flight of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites, including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), the European Space Agency's Advanced Scatterometer (ASCAT), Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Beatriz.

The U.S. Air Force Reserve Hurricane Hunters conducted one mission into Beatriz. The maximum flight-level (700 mb) wind measured in Beatriz was 74 kt in the northeast quadrant at 1807 UTC 20 June, followed by a dropsonde measurement of a mean wind of 76 kt in the lowest available 150 m. The maximum SFMR wind estimate was 70 kt at 1803 UTC. The aircraft reported a minimum pressure on the first eyewall penetration around 1800 UTC of 991 mb, and 989 mb on the second fix at 2001 UTC. The intensification observed by the plane continued during the next 12 h as the center approached the coast, and the analyzed peak intensity of 80 kt around 0600 UTC 21 June represents a compromise of satellite estimates of 4.5 to 5.0 (77 to 90

kt) from TAFB, SAB, and the Advanced Dvorak Technique (ADT) technique from University of Wisconsin-Cooperative Institute for Meteorological Satellite Studies (UW-CIMSS).

The best track shows the center of Beatriz passing within 15 n mi of the coast around 0600 UTC 21 June. Since a part of the coast passed within the hurricane's strike circle², Beatriz is counted as a hurricane strike in Mexico. Given the abrupt weakening that occurred after this time and the greater uncertainty in the available center fixes for a weaker system, it is possible that the center briefly moved inland, even though there is no direct evidence of this occurring. Regardless, it is likely that sustained hurricane-force winds occurred over a small portion of the southwestern coast of Mexico.

There were no ship reports nor land observations of tropical-storm-force winds or greater in association with Beatriz.

c. Casualty and Damage Statistics

According to press reports, heavy rains, high waves, and strong winds affected portions of the coast of the Mexico from the states of Guerrero to Jalisco. The heavy rains uprooted trees and flooded homes and roads, with severe flooding reported in sections of Acapulco. The maximum reported rainfall amounts by state include 222.5 mm (8.76 in) at Copala in Guerrero, 167.5 mm (6.59 in) in Lázaro Cárdenas in Michoacán, and 159 mm (6.26 in) in Callejones in Colima.

There was one death directly attributed to Beatriz. Media reports indicate that a stream, quickly rising as a result of heavy rains related to the storm, swept away a teenage boy. Three indirect deaths occurred in Amatillo, a municipality of Acapulco, after a father and son drowned while attempting to rescue the boy's mother, who had fallen through the boards covering a septic tank. The mother also drowned.

d. Forecast and Warning Critique

The genesis of Beatriz was well forecast. The disturbance from which Beatriz developed was introduced into the Tropical Weather Outlook with a low (0 to 20%) chance of genesis 108 h prior to its formation. The probability of genesis was raised to a medium chance (30 to 50% chance) 72 h prior to genesis and reached the high category (greater than 60% chance) 30 h before.

A verification of NHC official track forecasts for Beatriz is given in Table 2a. Official forecast track errors were smaller than the mean official errors for the previous 5-yr period at all forecast times except 12 h. The official errors were especially small at 48 h, about half of the 5-yr mean values. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. Most of the consensus track aids and GHMI were either

² A circle of 125 n mi diameter, centered 125 n mi to the right of the hurricane center (looking in the direction of motion). This circle is meant to depict the typical extent of hurricane-force winds which are approximately 75 n mi to the right and 50 n mi to the left of the center.

competitive with or beat the official forecast at all forecast times through 36 h, albeit for a small data set.

A verification of NHC official intensity forecasts for Beatriz is given in Table 3a. Official intensity errors were larger than the mean official errors for the previous 5-yr period at all forecast times and especially at 36 h and 48 h. Although intensity forecasts anticipated the rapid intensification of Beatriz as it neared the coast of southwestern Mexico, they did not similarly anticipate the rapid decay of the cyclone resulting from its interaction with land. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. Nearly all of the intensity guidance at all forecast times outperformed the official forecast, with the GHMI having the lowest overall errors. The ICON and IVCN intensity consensus guidance also performed reasonably well, with substantially lower errors relative to the official forecast (OFCL) at 36 h and 48 h. However, at those later times, the small number of forecasts suggests that no meaningful conclusions can be drawn.

Watches and warnings associated with Beatriz are given in Table 5. The portion of the southwestern coast of Mexico that likely observed hurricane conditions had a lead time of close to 36 h after the hurricane warning was issued.

Table 1. Best track for Hurricane Beatriz, 19-22 June 2011.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 1800	12.4	97.2	1006	25	low
19 / 0000	12.7	98.1	1006	25	"
19 / 0600	13.1	99.0	1006	25	tropical depression
19 / 1200	13.6	99.9	1005	30	"
19 / 1800	14.1	100.7	1004	35	tropical storm
20 / 0000	14.7	101.5	1001	40	"
20 / 0600	15.3	102.2	997	50	"
20 / 1200	16.2	102.6	994	60	"
20 / 1800	16.7	102.9	989	70	hurricane
21 / 0000	17.4	103.2	987	70	"
21 / 0300	17.9	103.4	983	75	"
21 / 0600	18.5	104.0	977	80	"
21 / 0900	18.8	104.4	981	70	"
21 / 1200	19.0	105.0	987	60	tropical storm
21 / 1800	19.0	105.5	996	40	"
22 / 0000	19.0	105.9	1003	25	tropical depression
22 / 0600					dissipated
21 / 0600	18.5	104.0	977	80	Maximum wind and minimum pressure

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Beatriz, 19-22 June 2011. Mean errors for the 5-year period 2006-10 are shown for comparison. Official errors that are smaller than the 5-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Beatriz)	37.6	43.6	45.8	46.2			
OCD5 (Beatriz)	55.1	82.2	115.4	167.9			
Forecasts	9	7	5	3			
OFCL (2006-10)	29.7	49.9	69.0	86.6			
OCD5 (2006-10)	38.4	74.8	115.3	155.9			

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Beatriz, 19-22 June 2011. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 2a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	34.0	35.8	59.7	23.5			
OCD5	42.0	87.4	157.7	157.1			
GFSI	51.7	80.8	150.9	123.9			
GHMI	31.2	37.0	43.4	74.2			
HWFI	43.5	62.0	94.2	107.1			
NGPI	29.2	44.0	81.7	72.1			
CMCI	45.6	66.0	100.7	196.4			
UKMI	40.0	36.5	104.6	261.5			
EGRI	40.0	36.5	93.1	167.2			
EMXI	33.8	36.3	79.6	66.2			
AEMI	62.1	85.3	138.5	122.2			
FSSE	32.1	39.6	69.7	68.4			
TCON	32.4	34.6	72.2	63.6			
TVCN	27.0	33.2	71.2	65.0			
TVCC	30.3	35.7	51.3	51.1			
GUNA	33.3	38.8	77.3	67.3			
LBAR	43.0	92.0	143.4	157.1			
BAMD	39.3	55.2	83.7	36.4			
BAMM	39.1	54.1	100.1	72.0			
BAMS	39.8	57.9	98.8	87.6			
Forecasts	4	3	2	1			

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Beatriz, 19-22 June 2011. Mean errors for the 5-year period 2006-10 are shown for comparison. Official errors that are smaller than the 5-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Beatriz)	15.6	20.7	26.0	25.0			
OCD5 (Beatriz)	13.3	18.4	22.6	18.0			
Forecasts	9	7	5	3			
OFCL (2006-10)	6.3	10.5	13.7	15.1			
OCD5 (2006-10)	7.3	11.9	15.3	17.6			

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Beatriz, 19-22 June 2011. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	17.5	22.5	30.0	35.0			
OCD5	14.5	18.8	23.5	25.0			
GHMI	16.6	15.2	13.3	1.0			
HWFI	15.5	21.0	31.5	19.5			
DSHP	16.9	21.5	27.8	34.5			
LGEM	17.6	22.3	27.5	34.0			
ICON	15.6	19.5	23.0	12.5			
IVCN	17.0	19.0	22.3	11.5			
FSSE	14.9	20.2	24.3	23.5			
Forecasts	8	6	4	2			

Table 4. Watch and warning summary for Hurricane Beatriz, 19-22 June 2011.

Date/Time (UTC)	Action	Location
19 / 1500	Tropical Storm Warning issued	Tecpan de Galeana to Punta San Telmo
19 / 1500	Hurricane Watch issued	Zihuatanejo to Manzanillo
19 / 2100	Hurricane Watch changed to Hurricane Warning	Zihuatanejo to Manzanillo
19 / 2100	Tropical Storm Warning area modified to	Tecpan de Galeana to Zihuatanejo
19 / 2100	Hurricane Watch issued	Manzanillo to La Fortuna
20 / 0900	Tropical Storm Warning issued	La Fortuna to Cabo Corrientes
20 / 0900	Hurricane Watch area modified to	La Fortuna to Cabo Corrientes
20 / 0900	Hurricane Warning area modified to	Zihuatanejo to La Fortuna
20 / 2100	Tropical Storm Warning discontinued	La Fortuna to Cabo Corrientes
20 / 2100	Hurricane Watch discontinued	All
20 / 2100	Hurricane Warning area modified to	Zihuatanejo to Cabo Corrientes
21 / 0600	Tropical Storm Warning discontinued	All
21 / 0900	Hurricane Warning area modified to	Lázaro Cardenas to Cabo Corrientes
21 / 1500	Hurricane Warning area modified to	La Fortuna to Cabo Corrientes
21 / 1800	Hurricane Warning discontinued	All

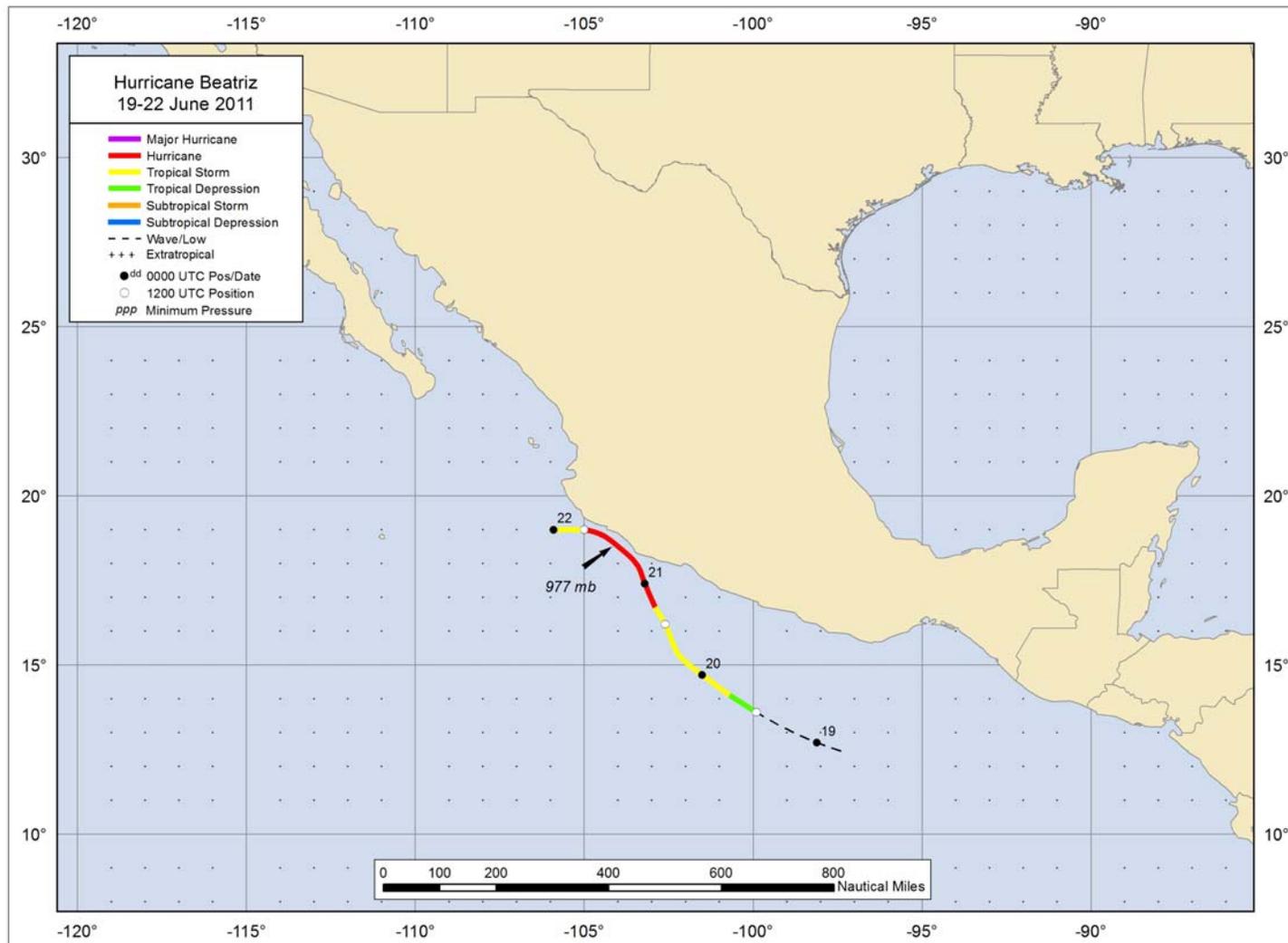


Figure 1. Best track positions for Hurricane Beatriz, 19-22 June 2011.

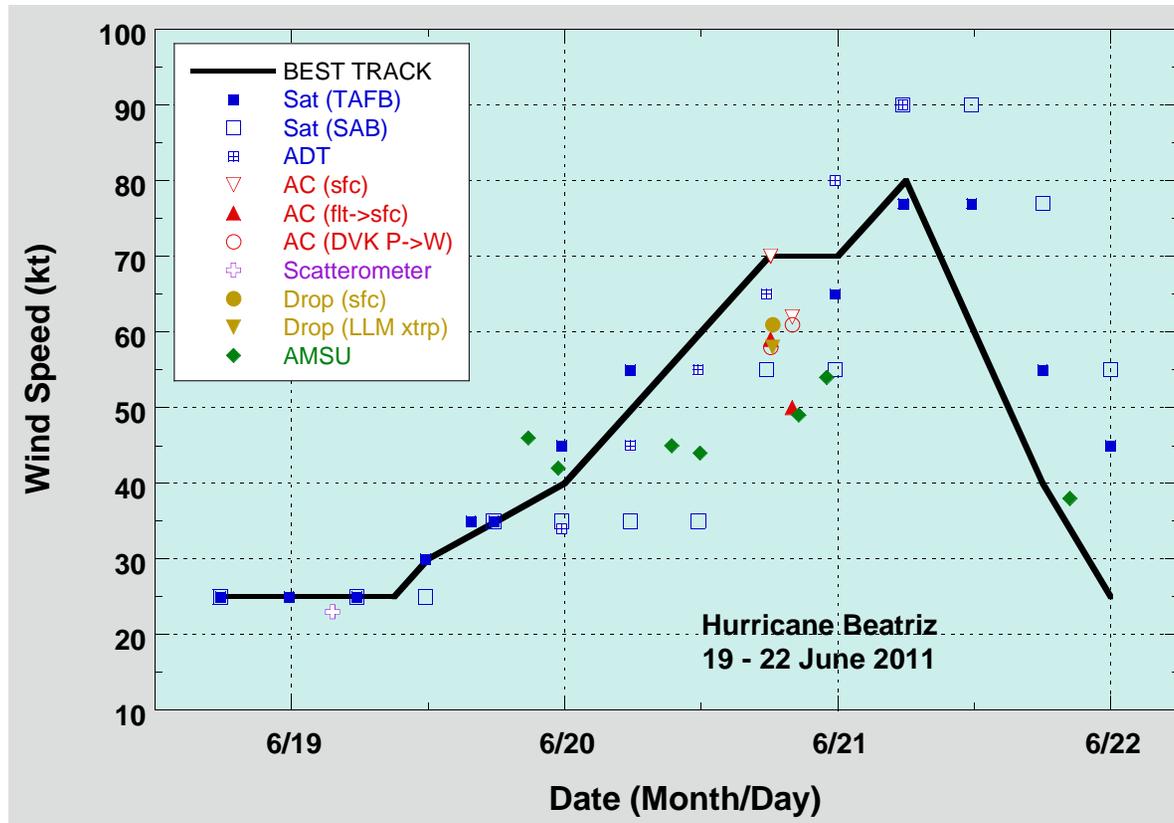


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Beatriz, 19-22 June, 2011. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC.

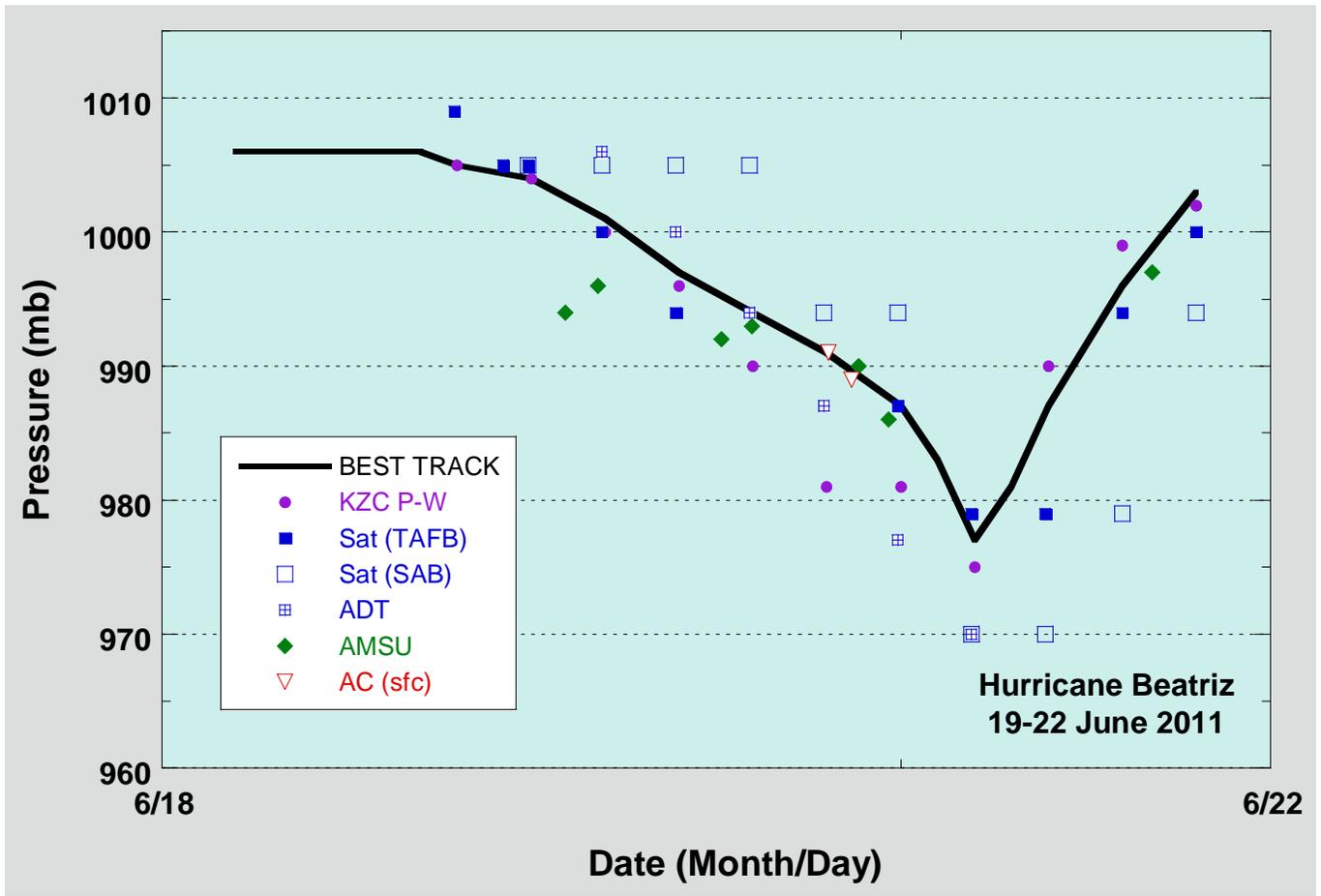


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Beatriz, 19-22 June 2011. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship.

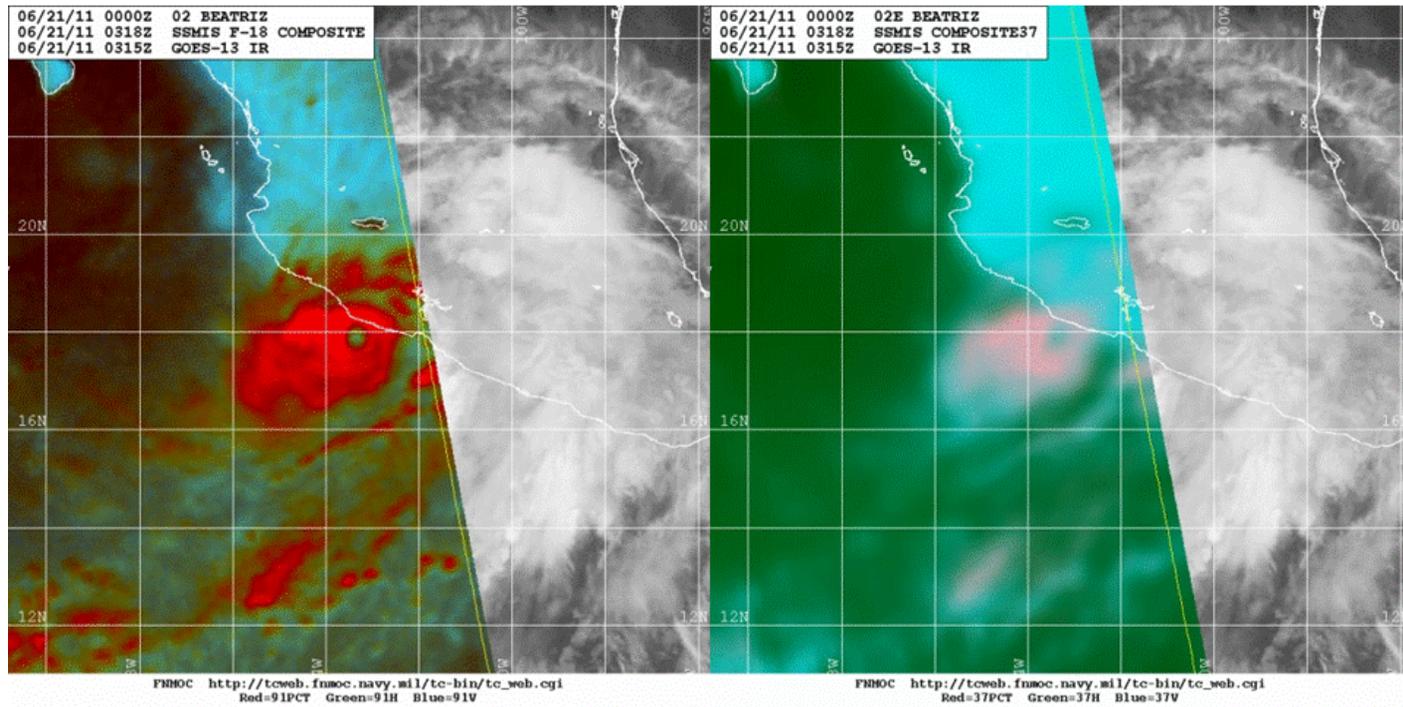


Figure 4. SSMIS 91- and 37-GHz images of Hurricane Beatriz (left and right, respectively) near peak intensity immediately offshore of the southwestern coast of Mexico at 0318 UTC 21 June 2011. Images courtesy of the Naval Research Laboratory.